MSAPC ADVISORY CIRCULAR

U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF AIR AND WASTE MANAGEMENT ● MOBILE SOURCE AIR POLLUTION CONTROL

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SUBJECT: Criteria for Approval of Use of a Chassis Dynamometer for Service Accumulation

A. Purpose

The purpose of this Advisory Circular is to explain the requirements that a chassis dynamometer and associated equipment must meet to be considered a satisfactory road-load simulator for service accumulation.

B. Background

On January 5, 1977, EPA published regulations (42 FR 1122) for certification of 1978 and later model year motorcycles. The regulations established a procedure for service accumulation and state that a modified procedure may be used if approved in advance by EPA (40 CFR 86.426-78). A modified procedure employing a chassis dynamometer road-load simulator may be approved under the provisions of this Advisory Circular. Once the chassis dynamometer road-load simulator is approved, the manufacturer may use it for part or all of the service accumulation on certification test vehicles.

C. Applicability

The provisions of this Advisory Circular are effective immediately and are applicable to large-volume manufacturers of 1978 and later model year motorcycles. The guidelines described in this Advisory Circular apply to indoor and outdoor chassis dynamometer road-load simulators.

D. General Requirements

1. A manufacturer may request EPA approval to use a chassis dynamometer for service accumulation on test vehicles for specific engine displacement-system combinations or for the manufacturer's entire test fleet. Approval to use a chassis dynamometer for service accumulation will be based upon data which demonstrate the ability of the chassis dynamometer and related systems to simulate accurately the temperature and load conditions of a driver-controlled vehicle operated on an EPA approved road route.

2. Requirements may vary among manufacturers due to differences in vehicles and emission control systems. For example, a vehicle equipped with a catalyst may require greater attention and additional equipment to maintain similarities in road to dynamometer relationships than would a vehicle not so equipped. Therefore, the characteristics of the vehicles for which approval to use a chassis dynamometer for service accumulation is sought will determine the number of demonstration vehicles from which temperature and engine load data must be generated. For the purpose of showing that a chassis dynamometer system is capable of simulating actual on-the-road driving, EPA will require not more than three demonstration vehicles per application for certification. Vehicle characteristics which EPA will use as a basis for specifying the number and types of demonstration vehicles include:

(a) Catalyst or thermal reactor usage

(b) Catalyst or thermal reactor location

(c) Engine configuration (i.e., number of cylinders, in-line or V-type, water-cooled or air-cooled, 2-stroke or 4-stroke, displacement)

(d) Vehicle shape and ground clearance

(e) Inertial mass class

E. Specific Requirements for Approval to Use Chassis Dynamometers

1. In order to qualify a chassis dynamometer system, it will be necessary to show similarity in conditions between the demonstration vehicle(s) (not an official certification test vehicle) when driven on an existing approved test route representing at least three laps (laps 2, 10 and 11) of the Durability Driving Schedule, 40 CFR Part 86, Appendix IV, and the same vehicle when operated on a chassis dynamometer representative of the system for which approval is sought. This similarity may be determined on the basis of data recorded on one day or for a longer period.

2. Data plots or recordings of the following variables must be provided. The data shall be recorded continuously or at sufficiently close intervals to evaluate transient conditions. The data shall be generated on the road and on the dynamometer using the same instrumentation and shall be displayed on the same scale. The vehicle shall be driven on the road route and then the dynamometer.

Variable

a. Temperature

Parameter to be Measured	Location of Thermocouple
(1) Cooling air	At front axle centerline (either side)
(2) Engine inlet air	At the clean side of the air filter
(3) Engine oil	In sump, at drainplug or near dipstick
(4) Transmission oil	In sump, at drainplug or near dipstick

mometer continues to correspond to the actual load requirements on the road. These checks should be made at least once at an intermediate point during service accumulation. Discrepancies revealed by these checks must be corrected before continuing service accumulation.

2. It is important that malfunctions to vehicles accumulating service on a chassis dynamometer be recognized with no more time lag than would occur if the vehicle were accumulating service on the road.

a. Since the road simulator causes the driver to be eliminated from the feedback network, the manufacturer may utilize some type of monitoring system to detect any potential vehicle or dynamometer malfunction. This approach is particularly desirable for a road simulator installation in which auxiliary power (electric motor or equivalent) is used to simulate inertia or downhill operation. With this type of installation, auxiliary power may compensate in case of vehicle malfunction or general vehicle deterioration by "driving" the crippled vehicle. If the manufacturer does not utilize such a detection system, frequent on-the-road evaluations must be made. These evaluations shall be made at the midpoint (± 250km) of each service accumulation interval. Exhaust gas analysis is not an acceptable technique for determining vehicle or dynamometer malfunctions.

b. In most cases, EPA will require that an indication of vehicle malfunction detected during dynamometer operation be verified by an on-the-road evaluation to determine the need for unscheduled maintenance. The test vehicle shall be driven on an approved service accumulation road route for a period sufficient to be able to determine whether an overt indication of malfunction is present.

3. It is the manufacturer's option to alternate between an approved chassis dynamometer system and an approved service accumulation road route. However, a change from one to the other must be recorded on the respective vehicle log sheet with the corresponding system distance.

I. Data to be Recorded

1. For all vehicles accumulating distance on a chassis dynamometer, the following data shall be recorded and maintained by the manufacturer:

a. A continuous record of vehicle speed versus time. This record will serve the same purpose as a tach-o-graph from a test vehicle operated on the road and must reflect the service accumulation route submitted in the application for certification;

b. A record of ambient temperatures (outdoor, indoor, and cooling fan outlet) recorded at intervals not exceeding one hour. This record is to verify that the requirements of Section E.3 and E.4 have been met;

c. On chassis dynamometers which do not control manifold vacuum, wheel (or dynamometer) torque, or throttle position an hourly check of an engine load indicating parameter. This record is to verify that the simulation of the original road-load requirements has been maintained;

d. A record of chassis dynamometer system maintenance or load setting adjustments made to maintain the relationship established in Section I.1.c above; and,

e. A record of actual vehicle system distance accumulated while on the dynamometer.

2. These data shall be made available to EPA upon request. If the data do not meet the requirements of Section I.1 above, EPA will consider whether modifications in the procedure need to be made, whether the vehicle should no longer accumulate service on the chassis dynamometer, or, depending upon the extent of the variation, if the vehicle will be disqualified.

(5)	(a) Spark plug seat (air cooled engine)	One required for each spark plug (unless otherwise specified by EPA)
	(b) Coolant (liquid cooled engine)	At both inlet and outlet of engine
(6)	Catalyst container (if applicable)	Skin at inlet and outlet
(7)	Exhaust pipe	Skin near connection to cylinder head (one required for each pipe unless otherwise specified by EPA)
(8)	Muffler	Skin at outlet

b. Manifold vacuum, wheel (or dynamometer) torque, or throttle position

c. Vehicle speed or wheel speed

d. Engine speed

3. Approval for use of chassis dynamometers will be given only for ambient temperatures within ±17C (30°F) of the mean ambient temperature recorded with the demonstration vehicle (Section E.2.a(1) above). Therefore, if the manufacturer wishes adequate assurance that his test vehicles may accumulate service on the chassis dynamometer during wide temperature variations, he will need to repeat the temperature recordings on the demonstration vehicle until information is available covering the normally expected range of ambient temperatures during the testing period. Operation of a test vehicle at ambient temperatures differing by more than 17°C from the demonstration ranges will be permitted for a total of 5 days. Once approval to use a chassis dynamometer is given, the manufacturer may submit additional data on wider temperature ranges than those recorded by the original demonstration vehicle. EPA may then, upon review of the additional data, extend its original approval to cover the operation of test vehicles at ambient temperatures within 17°C (30°F) of the revised temperature range.

4. Manufacturers may utilize an indoor chassis dynamometer to accumulate distance if in the dynamometer room ambient temperature in the area adjacent to the motorcycle reflects the outdoor ambient temperature within 5°C (10°F). This 5°C temperature constraint is in addition to the other requirements for approval of outdoor chassis dynamometers.

F. Criteria for Acceptance

1. It is generally recognized that two drivers operating the same vehicle over the same test route and using the same prescribed driving schedule will show variations in driving patterns as reflected in manifold vacuum, acceleration rates, and temperature transients. It is, therefore,

not necessary that the values of these parameters obtained on the dynamometer exactly duplicate the values obtained on the road. In addition, exact mechanical precision on the part of the road simulator is not considered an accurate simulation of the driver-controlled vehicle since few, if any, drivers are capable of accelerating, decelerating or driving a steady speed over a variable road terrain without random variations in the load-speed pattern. Therefore, the demonstrated simulated load-speed traces should show normal variations similar to, but not necessarily an exact replica of, those shown on the actual road-driven route.

2. Generally, the temperature versus time curves of each parameter measured with the motorcycle on the dynamometer should agree with the temperature versus time curve of that parameter measured with the motorcycle on the road as follows:

On-Road Temperature	On-Dyno Temperature
40°C (100°F) or less	± 5°C (10°F) of on-road temperature
greater than 40°C (100°F) but less than 150°C (300°F)	+ 10% to -5°C (10°F) of on-road temperature
150°C (300°F) or greater	± 10% of on-road temperature

Certain vehicle configurations in special circumstances may serve as grounds for wider tolerances.

3. The relation between engine speed and vehicle (or wheel) speed, both on the road and on the dynamometer, must be established in order to ascertain that transmission shift points on the dynamometer essentially duplicate the pattern observed on the road.

4. There is no specification in 40 C.R Part 86 relative to grade or condition of the road terrain, and a wide variety of grade and terrain conditions exist in the durability routes described by the manufacturers in their applications for certification. A road simulator matching any approved durability route is satisfactory.

G. Request for Authorization to Use Chassis Dynamometers

Requests for authorization to use a chassis dynamometer system for service accumulation must be made prior to the time the system is used for certification purposes and must be included with or added to the Part I Application for Certification. Approval to use a chassis dynamometer system may be given for specific groups of vehicles or for all of a manufacturer's vehicles, depending upon the nature of his request and the adequacy of the data submitted.

H. Vehicle Operation on the Dynamometer After Approval is Given

1. For dynamometer systems which control manifold vacuum (or throttle position), it is important to make periodic checks to determine if the manifold vacuum (or throttle position) as controlled on the chassis dyna-